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Subject: Entomological Input to the Salmon Timber Sale Analysis,
Cannell Meadow District, Sequoia NF (FPM Report No. C96-13)

To: Kathy Roche, Silviculturist, Cannell Meadow District

In September of 1996, the Decision Notice for the Salmon Timber Sale Environmental Assessment was withdrawn to provide additional opportunity for analysis. Locations in the Salmon planning area were visited by John Wenz, Forest Pest Management (FPM) South Sierra Shared Service Area entomologist and Kathy Roche, Ray Huber and other Cannell Meadow District personnel on June 19, 1996. The purpose of this report is to provide input to the analysis that addresses entomological questions raised by the District.

The Salmon project area encompasses the portion of the Salmon Creek watershed east of Salmon Creek Falls on the Kern Plateau and covers approximately 15,200 acres (T23/24S R33/34E). The stands evaluated were mixed conifer with Jeffrey pine being the most prevalent species with lesser amounts of white fir, sugar and lodgepole pine and black oak. Stocking levels were also quite variable with basal areas exceeding 350 sq.ft./acre to 400 sq.ft./acre in many locations. The primary insect and disease complex present in the project area involves the Jeffrey pine beetle (JPB), Dendroctonus jeffreyi (Coleoptera: Scolytidae) and western dwarf mistletoe, Arceuthobium campylopodum. The emarginate pine engraver, Ips emarginatus, was found associated with a small proportion of the mortality. Several pockets of Jeffrey pine mortality varying from 2-3 to 10-15 trees/pocket were observed scattered throughout the project area. Western dwarf mistletoe was present over approximately 60% to 70% of the area evaluated with the severity of infection varying considerably from location to location.

Jeffrey Pine Beetle Biology

The Jeffrey pine beetle (JPB) is the principal bark beetle found attacking Jeffrey pine, Pinus jeffreyi, which is its only host. It is a native insect occurring throughout the range of Jeffrey pine from southwestern Oregon southward through California and western Nevada to northern Mexico. The beetle normally breeds in large, slow-growing, mature and/or stressed trees. Under such conditions, mortality usually occurs as scattered, individual trees as opposed to large groups. Under outbreak conditions, often triggered by drought or other factors that weaken trees and predispose them to JPB attack, pines with diameters >6 inches DBH are attacked. Mortality under these conditions often occurs in large groups of from 30 to 100 or more trees. The JPB is not known to successfully breed in slash.

The JPB usually completes one generation per year in the northern part of its range and at higher elevations (Cannell Meadows) but may complete two generations in the south. The adults generally fly and attack between late-May/early-June and early-October. The adults are cylindrical, reddish-brown to black, and are about 5/16 inch in length. Upon successfully attacking a Jeffrey pine, usually in the mid to lower bole, the adult JPB excavate a longitudinal egg gallery in the cambium/inner bark that often has a distinctive "J" shaped segment at the bottom. The eggs are laid in niches along the sides of the egg gallery which is packed with frass. After egg hatch, the larvae feed in mines perpendicular to the egg gallery and end in open, oval-shaped pupal cells in which pupation occurs. The JPB tends to overwinter as larvae and adults.

Jeffrey pine attacked by JPB can be identified by reddish pitch tubes on the bole where adults have attacked and/or brownish to reddish frass (boring dust) that collects in bark crevices and at the base of the tree. Attacked trees also exhibit a sequence of crown fade from greenish yellow to reddish brown. Frequently, crowns do not begin to fade until the spring of the year following attack.

Several other organisms are often associated with the attack of the Jeffrey pine beetle. Bluestain fungi, yeasts, and other fungi are transferred into the tree by the attacking adults. The California flatheaded borer, Melanophila californica, the pine engraver, Ips pini, and the emarginate ips, I. emarginatus, may be found in JPB attacked trees.

Discussion

The following discussion is intended to address questions, primarily concerning JPB, raised by the District. As noted above, under "normal" environmental conditions, mortality associated with JPB activity is low and JPB population levels are also assumed to be low. The mortality is most common in older, mature, frequently large-diameter, Jeffrey pine. The underlying assumption is that the older, mature trees, are less vigorous and more susceptible to JPB attack. Thus it is likely that tree vigor more than tree size is the important factor relative to successful JPB attack although the importance of tree size (height and/or diameter) in host tree selection by JPB, particularly at low population densities, is not known.

Under the above conditions, smaller diameter (< 30 inches DBH) tree mortality involving JPB is very low but does occur. It usually occurs in scattered small groups of 2 to 3 trees (rarely > 5 trees) that tend not to expand the following year. Such mortality groups are often associated with overstocked stand conditions and sometimes with dwarf mistletoe infections which likely function to predispose the trees to JPB attack. Ips emarginatus are often associated with mortality to trees <14 inches DBH.

Jeffrey pine beetle mortality dynamics change when environmental conditions, specifically below normal precipitation, causes an increase in the susceptibility of large numbers of Jeffrey pine to successful JPB attack. Increased host susceptibility allows more trees to be successfully attacked and, presumably, for populations to increase, at least in the short term. Under such circumstances, trees > 6 inches in DBH are attacked. In addition, mortality can dramatically increase and mortality groups can expand from 2 to 5 trees per group to 100-200+ trees/group in 2 to 4 generations.

From the standpoint of preventive management, thinning to maintain stocking at levels that promote healthy, vigorous, growing conditions can reduce bark beetle-related mortality. In part because of JPB biology and host selection behavior, the condition of the host tree is an important influence on whether attacks will be successful. Well growing, healthy, conifers are more likely to resist bark beetle attacks through evolved defense mechanisms. Trees weakened by moisture stress, fire, physical injury, disease or between-tree competition due to overstocking are more likely to be killed.

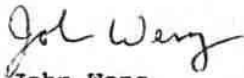
The relationship between stocking density and bark beetle mortality has been documented for ponderosa pine (Fiddler, G.O, Hart, D.R., Fiddler, T.A., and P.M. McDonald. 1989. Thinning Decreases Mortality and Increases Growth of Ponderosa Pine in Northeastern California. USDA Forest Service Research Paper PSW-194. 7pp; Oliver, W.W. 1995. Is Self-thinning in Ponderosa Pine Ruled by Dendroctonus Bark Beetles? In: Eskew, L.G. (comp.) Forest health through silviculture. Proc. 1995 Natl. Silviculture Workshop: May 8-11, Mescalero, NM. USDA For. Serv. Gen. Tech. Rep. RM-GTR-267. 246 pp.), and there is no reason to think that the underlying assumptions are not valid for Jeffrey pine. Although not quantified, overstocked stands and stands with moderate to heavy dwarf mistletoe infection levels are at increased risk to JPB attacks (and initiation of an epidemic) compared to stands thinned to appropriate levels. The risk of attack probably increases for stands with both overstocking and high dwarf mistletoe infections (see FPM Report No. C96-10, September 10, 1996, for dwarf mistletoe management discussion).

Thinning around individual or small concentrations of large-diameter trees is likely to be beneficial with respect to preventing successful JPB attacks. Trees that have culminated in height growth are not likely to show a marked increase in growth as a result of thinning. However, to the extent that the thinning increases moisture availability to the large-diameter trees, they should be better able to maintain their current state of health and help reduce chances of successful JPB attack. Increasing the amount of available moisture should increase the ability of attacked trees to activate their defense mechanisms and prevent successful attacks.

If actions (thinning/ dwarf mistletoe control) are not taken to to change or mitigate factors associated with undesirable insect and pathogen effects, it is likely that there will be a trend toward increasing mortality through time. There will be annual, periodic, fluctuations, but an increasing probability of large mortality groups developing over 1 to 3 year periods, particularly during times of below normal precipitation. Such mortality will increase the amount of standing and down woody material which can affect the need/opportunity for

salvage and result in increased fuel loading, increased wildlife habitat for snag and down woody material dependent species, increased decomposition and nutrient cycling and, depending on location, the creation of hazardous trees.

If there are any additional questions or concerns, contact the FPM Service Area office in Sonora at (209) 532-3671.



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